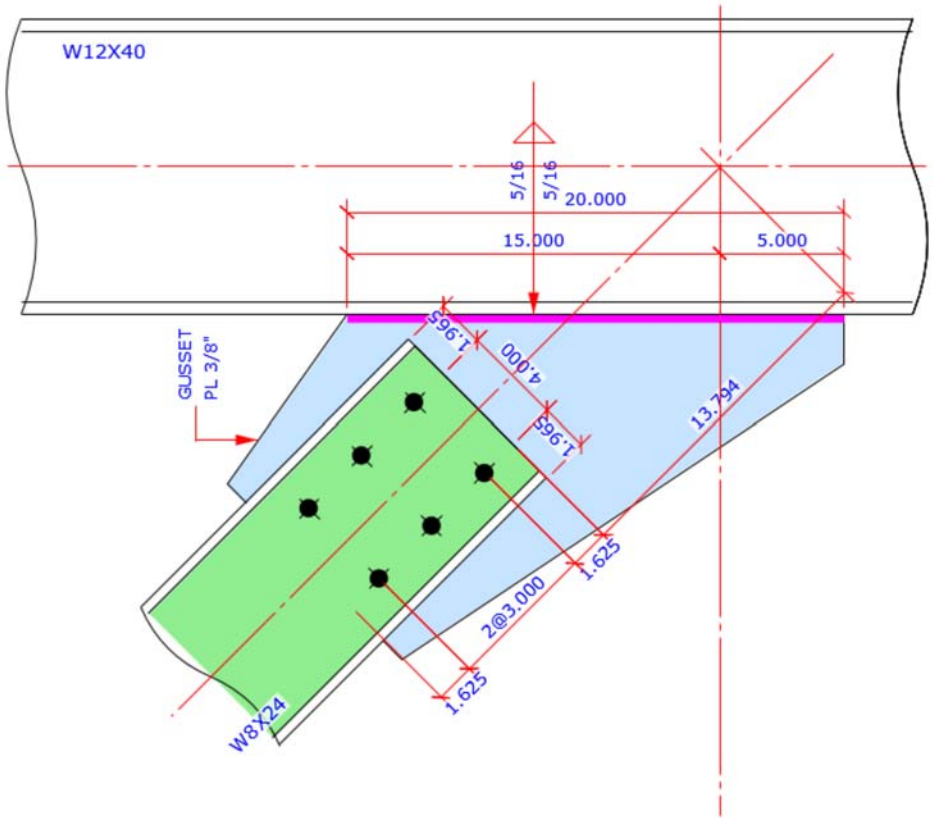
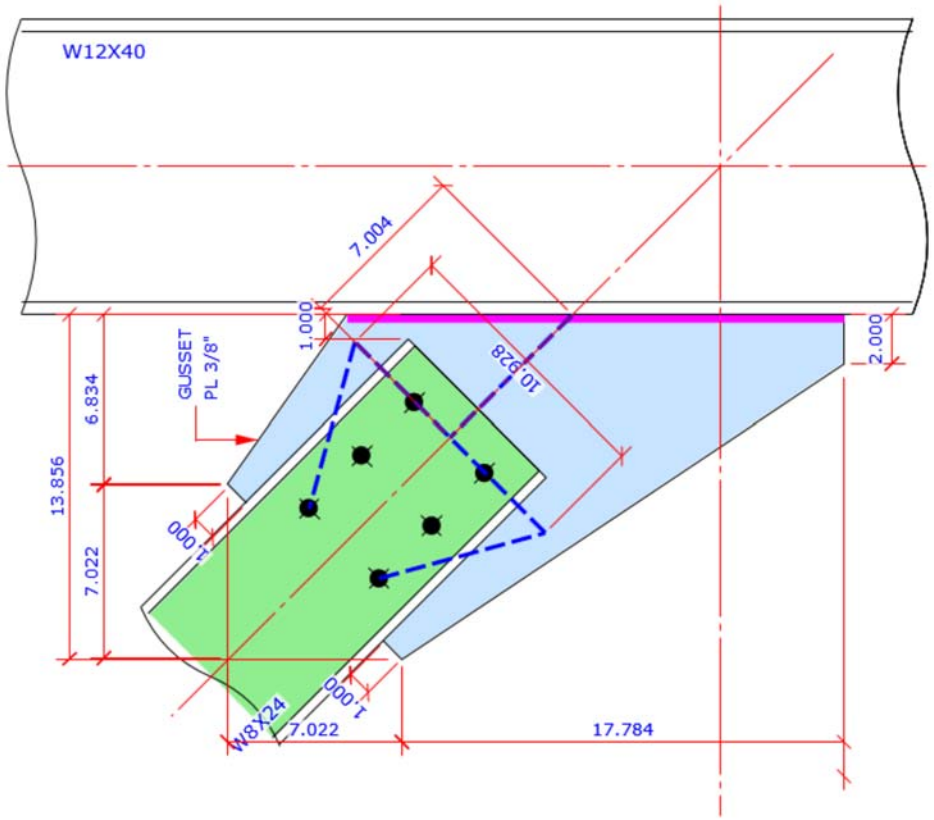
Result Summary - Overall	Vertical Brace Connection	Code=AISC 360-10 LRFD

Result Summary - Overall	geometries & weld limitations = **PASS**	limit states max ratio = **0.88**	**PASS**
Brace to Gusset	geometries & weld limitations = **PASS**	limit states max ratio = **0.88**	**PASS**
Gusset to Beam	geometries & weld limitations = **PASS**	limit states max ratio = **0.28**	**PASS**

Sketch	Vertical Brace Connection	Code=AISC 360-10 LRFD




W12X40
7.004
1.000
2.000
10.928
GUSSET
PL 3/8"
6.834
13.856
7.022
1.000
1.000
W8X24
7.022
17.784

Members & Components Summary

Member	Brace Connection				Code=AISC 360-10 LRFD
Column Section					
W12X40	d = 11.900	[in]	b_f = 8.010	[in]	
	t_f = 0.515	[in]	t_w = 0.295	[in]	
	k_{des} = 1.020	[in]	k_{det} = 1.375	[in]	
	k_1 = 0.875	[in]	A = 11.700	[in^2]	
	S_x = 51.50	[in^3]	Z_x = 57.00	[in^3]	
Steel Grade A992	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]	

Gusset Plate Interface Forces Calculation

Brace Axial Force Load Case 1				
Brace axial force	P = from user input	= -50.00	[kips]	in tension
Brace to ver line angle	θ = from user input	= 45.0	[°]	
Gusset - column axial	N = P sin θ	= **-35.36**	[kips]	in tension
Gusset - column shear	V = P cos θ	= **-35.36**	[kips]	
Brace Axial Force Load Case 2				
Brace axial force	P = from user input	= 50.00	[kips]	in compression
Brace to ver line angle	θ = from user input	= 45.0	[°]	
Gusset - column axial	N = P sin θ	= **35.36**	[kips]	in compression
Gusset - column shear	V = P cos θ	= **35.36**	[kips]	

Brace to Gusset	Sect=W8X24	P_{LC1} =-50.00 kips (T)	P_{LC2} =50.00 kips (C)	Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.88**	**PASS**

Geometry Restriction Checks - W Brace to Gusset					**PASS**
Min Bolt Edge Distance - W Brace to Gusset					
Bolt diameter	d_b =		= 0.750	[in]	
Min edge distance allowed	$L_{e\text{-}min}$ =		= **1.000**	[in]	AISC 14th Table J3.4
Min edge distance in W Brace to Gusset	L_e =		= **1.625**	[in]	
			> $L_{e\text{-}min}$	OK	
Min Bolt Spacing - W Brace to Gusset					
Bolt diameter	d_b =		= 0.750	[in]	
Min bolt spacing allowed	$L_{s\text{-}min}$ = 2.667 d_b		= **2.000**	[in]	AISC 14th J3.3
Min Bolt spacing in W Brace to Gusset	L_s =		= **3.000**	[in]	
			> $L_{s\text{-}min}$	OK	

Brace Force Load Case 1 Sect=W8X24 P =-50.00 kips (T) ratio = **0.88** **PASS**

W Brace End with Blocked Flanges - Tensile Yield			ratio = 50.00 / 206.01	= **0.24**	**PASS**
W brace section	= W8X24				
	d = 7.930	[in]	b_f = 6.500	[in]	
	t_f = 0.400	[in]	t_w = 0.245	[in]	
	A = 7.080	[in^2]			
Gross section area after taking out blocked flanges area	$A_g = A - 0.5(b_f - t_w) t_f x 2$		= 4.578	[in^2]	
Gross area subject to tension	A_g =		= 4.578	[in^2]	
Steel yield strength	F_y =		= 50.0	[ksi]	
Tensile force required	P_u =		= **50.00**	[kips]	
Tensile yielding strength	$R_n = F_y A_g$		= 228.90	[kips]	AISC 14th Eq D2-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th D2 (a)
	ϕR_n =		= **206.01**	[kips]	AISC 14th Eq D2-1
	ratio = **0.24**		> P_u	OK	

W Brace End with Blocked Flanges - Tensile Rupture			ratio = 50.00 / 167.20	= **0.30**	**PASS**
Section gross area	A_g = W8X24		= 4.578	[in^2]	
Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]		bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b
Number of bolt row	n_v = 2		web t_w = 0.245	[in]	
Tensile net area	$A_n = A_g - n_v d_h t_w$		= 4.149	[in^2]	
No of bolt column	n_h = 3		bolt space s_h = 3.000	[in]	
Length of connection	$L = (n_h - 1) s_h$		= 6.000	[in]	
Eccentricity of connection	$\bar{x}$ = from sect W8X24		= 1.041	[in]	
Shear lag factor	$U = 1 - \bar{x} / L$		= 0.827		AISC 14th Table D3.1
Tensile force required	P_u =		= **50.00**	[kips]	
Tensile effective net area	$A_e = A_n U$		= 3.430	[in^2]	
Plate tensile strength	F_u =		= 65.0	[ksi]	
Tensile rupture strength	$R_n = F_u A_e$		= 222.93	[kips]	AISC 14th Eq D2-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th D2 (b)
	ϕR_n =		= **167.20**	[kips]	AISC 14th Eq D2-2
	ratio = **0.30**		> P_u	OK	

W Brace - Bolt Shear			ratio = 50.00 / 107.35	= **0.47**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750 [in]		bolt area A_b = 0.442	[in^2]	
Number of bolt carried shear	n_s = 6.0		shear plane m = 1		
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 143.14	[kips]	AISC 14th Eq J3-1
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1
	ϕR_n =		= **107.35**	[kips]	
	ratio = **0.47**		> V_u	OK	

W Brace - Slip Critical - W Brace Web/Gusset Plate			ratio = 50.00 / 56.95	= **0.88**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$ [in]		Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8
No of bolt row & column	n_r = 2		n_c = 3		
No of slip plane	n_s = 1				
Bolt group eccentricity coefficient	C_{ec} =		= 1.000		
Required shear strength	V_u =		= **50.00**	[kips]	
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 56.95	[kips]	AISC 14th Eq J3-4
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8
	ϕR_n =		= **56.95**	[kips]	
	ratio = **0.88**		> V_u	OK	

W Brace - Bolt Bearing on W Brace Web					ratio = 50.00 / 107.35	= **0.47**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N			F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2	
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442	[in^2]		
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$			= 23.86	[kips]	AISC 14th Eq J3-1	
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3	
Bolt spacing & edge distance	spacing L_s = 3.000	[in]		edge distance L_e = 1.625	[in]		
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.245	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$			= 2.188	[in]		
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$					AISC 14th Eq J3-6b	
	= 52.25 ≤ 35.83			= 35.83	[kips]		
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$			= 23.86	[kips]		
Edge Bolt							
Bolt hole edge clear distance	$L_c = L_e - d_h / 2$			= 1.219	[in]		
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\, L_c\, t\, F_u \le 3.0\, d_b\, t\, F_u$					AISC 14th Eq J3-6b	
	= 29.11 ≤ 35.83			= 29.11	[kips]		
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$			= 23.86	[kips]		
Number of bolt	interior n_{in} = 4			edge n_{ed} = 2			
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$			= 143.14	[kips]		
Required shear strength	V_u =			= **50.00**	[kips]		
Bolt resistance factor-LRFD	ϕ = 0.75					AISC 14th J3-10	
	ϕ R_n =			= **107.35**	[kips]		
	ratio = **0.47**			> V_u	OK		

W Brace - Bolt Bearing on Gusset Plate	ratio = 50.00 / 107.35	= **0.47**	**PASS**

Single Bolt Shear Strength

Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$		= 23.86	[kips]	AISC 14th Eq J3-1

Bolt Bearing / TearOut Strength on Plate

Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^{13}/_{16}$	[in]	AISC 14th Table J3.3
Bolt spacing & edge distance	spacing L_s = 3.000	[in]	edge distance L_e = 1.625	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate thickness	t = 0.375	[in]			

Interior Bolt

Bolt hole edge clear distance	$L_c = L_s - d_h$	= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ F_u$			AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84	= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Edge Bolt

Bolt hole edge clear distance	$L_c = L_e - d_h / 2$	= 1.219	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}ed} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ F_u$			AISC 14th Eq J3-6b
	= 44.56 ≤ 54.84	= 44.56	[kips]	
Bolt strength at edge	$R_{n\text{-}ed} = \min(R_{n\text{-}t\&b\text{-}ed}, R_{n\text{-}bolt})$	= 23.86	[kips]	

Number of bolt	interior n_{in} = 4		edge n_{ed} = 2		
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in} + n_{ed} R_{n\text{-}ed}$		= 143.14	[kips]	
Required shear strength	V_u =		= **50.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th J3-10
	ϕR_n =		= **107.35**	[kips]	
	ratio = **0.47**		> V_u	OK	

W Brace Web - Block Shear - Center Strip ratio = 50.00 / 115.26 = **0.43** **PASS**

Plate Block Shear - Center Strip

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Plate thickness	t_p = 0.245 [in]				
Plate strength	F_y = 50.0 [ksi]	F_u = 65.0 [ksi]			
Bolt no in ver & hor dir	n_v = 2	n_h = 3			
Bolt spacing in ver & hor dir	s_v = 4.000 [in]	s_h = 3.000 [in]			
Bolt edge dist in ver & hor dir	e_v = 1.965 [in]	e_h = 1.625 [in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$	= 3.736	[in^2]		
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$	= 2.664	[in^2]		
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$	= 0.766	[in^2]		
Block shear strength required	V_u =	= **50.00**	[kips]		
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2
Bolt shear resistance provided	R_n = min ($0.6F_u A_{nv}$, $0.6F_y A_{gv}$) + $U_{bs} F_u A_{nt}$	= 153.68	[kips]		AISC 14th Eq J4-5
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5
	ϕR_n =	= **115.26**	[kips]		
	ratio = **0.43**	> V_u	OK		

Gusset Plate - Tensile Yield (Whitmore) ratio = 50.00 / 184.41 = **0.27** **PASS**

Plate Tensile Yielding Check

Plate size	width b_p = 10.928 [in]	thickness t_p = 0.375 [in]			
Plate yield strength	F_y = 50.0 [ksi]				
Plate gross area in shear	$A_g = b_p t_p$	= 4.098	[in^2]		
Tensile force required	P_u =	= **50.00**	[kips]		
Plate tensile yielding strength	$R_n = F_y A_g$	= 204.90	[kips]		AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =	= **184.41**	[kips]		
	ratio = **0.27**	> P_u	OK		

Gusset Plate - Tensile Rupture (Whitmore) ratio = 50.00 / 167.79 = **0.30** **PASS**

Plate Tensile Rupture Check

Bolt hole diameter	bolt dia d_b = $^3/_4$ [in]	bolt hole dia d_h = $^7/_8$ [in]			AISC 14th B4.3b
Number of bolt	n = 2				
Plate size	width b_p = 10.928 [in]	thickness t_p = 0.375 [in]			
Plate tensile strength	F_u = 65.0 [ksi]				
Plate net area in tension	$A_{nt} = (b_p - n d_h) t_p$	= 3.442	[in^2]		
Tensile force required	P_u =	= **50.00**	[kips]		
Plate tensile rupture strength	$R_n = F_u A_{nt}$	= 223.71	[kips]		AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =	= **167.79**	[kips]		AISC 14th Eq J4-2
	ratio = **0.30**	> P_u	OK		

Gusset Plate - Block Shear - Center Strip					ratio = 50.00 / 176.41	= **0.28**	**PASS**
Plate Block Shear - Center Strip							
Bolt hole diameter	bolt dia d_b = $^3/_4$	[in]	bolt hole dia d_h = $^7/_8$	[in]	AISC 14th B4.3b		
Plate thickness	t_p = 0.375	[in]					
Plate strength	F_y = 50.0	[ksi]	F_u = 65.0	[ksi]			
Bolt no in ver & hor dir	n_v = 2		n_h = 3				
Bolt spacing in ver & hor dir	s_v = 4.000	[in]	s_h = 3.000	[in]			
Bolt edge dist in ver & hor dir	e_v = 1.965	[in]	e_h = 1.625	[in]			
Gross area subject to shear	$A_{gv} = [(n_h - 1) s_h + e_h] t_p \times 2$		= 5.719	[in^2]			
Net area subject to shear	$A_{nv} = A_{gv} - [(n_h - 1) + 0.5] d_h t_p \times 2$		= 4.078	[in^2]			
Net area subject to tension when sheared out by center strip	$A_{nt} = (n_v - 1) (s_v - d_h) t_p$		= 1.172	[in^2]			
Block shear strength required	V_u =		= **50.00**	[kips]			
Uniform tension stress factor	U_{bs} = 1.00				AISC 14th Fig C-J4.2		
Bolt shear resistance provided	$R_n = \min (0.6F_u A_{nv}, 0.6F_y A_{gv}) + U_{bs} F_u A_{nt}$		= 235.22	[kips]	AISC 14th Eq J4-5		
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-5		
	ϕR_n =		= **176.41**	[kips]			
	ratio = **0.28**		> V_u	OK			

Brace Force Load Case 2 Sect=W8X24 P =50.00 kips (C) ratio = **0.88** **PASS**

W Brace - Bolt Shear					ratio = 50.00 / 107.35	= **0.47**	**PASS**
Bolt shear stress	bolt grade = A325-N		F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2		
	bolt dia d_b = 0.750	[in]	bolt area A_b = 0.442	[in^2]			
Number of bolt carried shear	n_s = 6.0		shear plane m = 1				
Required shear strength	V_u =		= **50.00**	[kips]			
Bolt shear strength	$R_n = F_{nv} A_b n_s m C_{ec}$		= 143.14	[kips]	AISC 14th Eq J3-1		
Bolt resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J3-1		
	ϕR_n =		= **107.35**	[kips]			
	ratio = **0.47**		> V_u	OK			

W Brace - Slip Critical - W Brace Web / Gusset Plate					ratio = 50.00 / 56.95	= **0.88**	**PASS**
Bolt dia & bolt pretension	dia d_b = $^3/_4$	[in]	Pretension T_b = 28.00	[kips]	AISC 14th Table J3.1		
Surface class	= Class A		Slip coeff. μ = 0.30		AISC 14th J3.8		
Min. bolt pretension	D_u = 1.13		Filler factor h_f = 1.00		AISC 14th J3.8		
No of bolt row & column	n_r = 2		n_c = 3				
No of slip plane	n_s = 1						
Bolt group eccentricity coefficient	C_{ec} =		= 1.000				
Required shear strength	V_u =		= **50.00**	[kips]			
Slip resistance	$R_n = \mu D_u h_f T_b n_s n_r n_c C_{ec}$		= 56.95	[kips]	AISC 14th Eq J3-4		
Resistance factor-LRFD	ϕ = 1.00	for standard size or SSLT hole			AISC 14th J3.8		
	ϕR_n =		= **56.95**	[kips]			
	ratio = **0.88**		> V_u	OK			

W Brace - Bolt Bearing on W Brace Web					ratio = 50.00 / 107.35	= **0.47**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]			bolt area A_b = 0.442	[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]			bolt hole dia d_h = 13/16	[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]					
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.245	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$				= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$						AISC 14th Eq J3-6b
	= 52.25 ≤ 35.83				= 35.83	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Number of bolt	interior n_{in} = 6						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 143.14	[kips]	
Required shear strength	V_u =				= **50.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕ R_n =				= **107.35**	[kips]	
	ratio = **0.47**				> V_u	OK	

W Brace - Bolt Bearing on Gusset Plate					ratio = 50.00 / 107.35	= **0.47**	**PASS**
Single Bolt Shear Strength							
Bolt shear stress	bolt grade = A325-N				F_{nv} = 54.0	[ksi]	AISC 14th Table J3.2
	bolt dia d_b = 0.750	[in]		bolt area A_b = 0.442		[in^2]	
Single bolt shear strength	$R_{n\text{-}bolt} = F_{nv} A_b$				= 23.86	[kips]	AISC 14th Eq J3-1
Bolt Bearing / TearOut Strength on Plate							
Bolt hole diameter	bolt dia d_b = 3/4	[in]		bolt hole dia d_h = 13/16		[in]	AISC 14th Table J3.3
Bolt spacing	spacing L_s = 3.000	[in]					
Plate tensile strength	F_u = 65.0	[ksi]					
Plate thickness	t = 0.375	[in]					
Interior Bolt							
Bolt hole edge clear distance	$L_c = L_s - d_h$				= 2.188	[in]	
Bolt tear out/bearing strength	$R_{n\text{-}t\&b\text{-}in} = 1.5\ L_c\ t\ F_u \le 3.0\ d_b\ t\ m\ F_u$						AISC 14th Eq J3-6b
	= 79.98 ≤ 54.84				= 54.84	[kips]	
Bolt strength at interior	$R_{n\text{-}in} = \min(R_{n\text{-}t\&b\text{-}in}, R_{n\text{-}bolt})$				= 23.86	[kips]	
Number of bolt	interior n_{in} = 6						
Bolt bearing strength for all bolts	$R_n = n_{in} R_{n\text{-}in}$				= 143.14	[kips]	
Required shear strength	V_u =				= **50.00**	[kips]	
Bolt resistance factor-LRFD	ϕ = 0.75						AISC 14th J3-10
	ϕ R_n =				= **107.35**	[kips]	
	ratio = **0.47**				> V_u	OK	

Gusset Plate - Compression (Whitmore) ratio = 50.00 / 118.68 = **0.42** **PASS**

Plate Compression Check

Plate size	width b_p = 10.928 [in]	thickness t_p = 0.375	[in]	
	F_y = 50.0 [ksi]	E = 29000	[ksi]	
Plate gross area in compression	$A_g = b_p t_p$	= 4.098	[in^2]	
Plate radius of gyration	$r = t_p / \sqrt{12}$	= 0.108	[in]	
Plate effective length factor	K =	= 1.20		
Plate unbraced length	L_u =	= 7.004	[in]	
Plate slenderness	$KL/r = 1.20 \times L_u / r$	= 77.64		
	when $\frac{KL}{r} > 25$, use Chapter E			AISC 14th J4.4 (b)
Elastic buckling stress	$F_e = \frac{\pi^2 E}{(KL/r)^2}$	= 47.48	[ksi]	AISC 14th Eq E3-4
	when $\frac{KL}{r} \le 4.71 \left(\frac{E}{F_y}\right)^{0.5}$ = 113.43			AISC 14th E3 (a)
Critical stress	$F_{cr} = 0.658^{(F_y/F_e)} F_y$	= 32.18	[ksi]	AISC 14th Eq E3-2
Plate compression required	P_u =	= **50.00**	[kips]	
Plate compression provided	$R_n = F_{cr} \times A_g$	= 131.86	[kips]	AISC 14th Eq E3-1
Bolt resistance factor-LRFD	ϕ = 0.90			AISC 14th E1
	ϕR_n =	= **118.68**	[kips]	
	ratio = **0.42**	> P_u	OK	

Gusset to Beam | Direct Weld Connection | Code=AISC 360-10 LRFD

Result Summary	geometries & weld limitations = **PASS**	limit states max ratio = **0.28**	**PASS**

Weld Limitation Checks - Gusset to Column — PASS

Min Fillet Weld Size

Thinner part joined thickness	t =	= 0.375	[in]	
Min fillet weld size allowed	w_{min} =	= **0.188**	[in]	AISC 14th Table J2.4
Fillet weld size provided	w =	= **0.313**	[in]	
		> w_{min}	OK	

Min Fillet Weld Length

Fillet weld size provided	w =	= 0.313	[in]	
Min fillet weld length allowed	L_{min} = 4 x w	= **1.250**	[in]	AISC 14th J2.2b
Min fillet weld length	L =	= **20.000**	[in]	
		> L_{min}	OK	

Brace Force Load Case 1 — Gusset plate t=0.375 — P = -50.00 kips (T) — ratio = **0.28** — **PASS**

Gusset Plate - Shear Yielding — ratio = 35.36 / 225.00 = **0.16** — PASS

Plate Shear Yielding Check

Plate size	width b_p = 20.000 [in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0 [ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$	= 7.500	[in^2]	
Shear force required	V_u =	= **35.36**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$	= 225.00	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00			AISC 14th Eq J4-3
	ϕR_n =	= **225.00**	[kips]	
	ratio = **0.16**	> V_u	OK	

Gusset Plate - Shear Rupture — ratio = 35.36 / 219.38 = **0.16** — PASS

Plate Shear Rupture Check

Plate size	width b_p = 20.000 [in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0 [ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$	= 7.500	[in^2]	
Shear force in demand	V_u =	= **35.36**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$	= 292.50	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75			AISC 14th Eq J4-4
	ϕR_n =	= **219.38**	[kips]	
	ratio = **0.16**	> V_u	OK	

Gusset Plate - Axial Tensile Yield			ratio = 35.36 / 337.50	= **0.10**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 20.000	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 7.500	[in^2]	
Tensile force required	P_u =		= **35.36**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 375.00	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **337.50**	[kips]	
	ratio = **0.10**		> P_u	OK	

Gusset Plate - Axial Tensile Rupture			ratio = 35.36 / 365.63	= **0.10**	**PASS**
Plate Tensile Rupture Check					
Plate size	width b_p = 20.000	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in tension	$A_{nt} = b_p t_p$		= 7.500	[in^2]	
Tensile force required	P_u =		= **35.36**	[kips]	
Plate tensile rupture strength	$R_n = F_u A_{nt}$		= 487.50	[kips]	AISC 14th Eq J4-2
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-2
	ϕR_n =		= **365.63**	[kips]	AISC 14th Eq J4-2
	ratio = **0.10**		> P_u	OK	

Gusset Plate - Flexural Yield Interact			ratio =	= **0.04**	**PASS**
Gusset plate	width b_p = 20.000	[in]	thick t_p = 0.375	[in]	
	yield F_y = 50.0	[ksi]			
Shear plate - gross area	$A_g = b_p \times t_p$		= 7.500	[in^2]	
Shear plate - plastic modulus	$Z_p = (b_p \times t_p^2) / 4$		= 37.500	[in^3]	
Flexural strength available	$M_c = \phi F_y Z_p$ ϕ=0.90		= 140.63	[kip-ft]	
Flexural strength required	M_r = from gusset interface forces calc		= 0.00	[kip-ft]	
Axial strength available	P_c = from axial tensile yield check		= 337.50	[kips]	
Axial strength required	P_r = from gusset interface forces calc		= 35.36	[kips]	
Shear strength available	V_c = from shear yielding check		= 225.00	[kips]	
Shear strength required	V_r = from gusset interface forces calc		= 35.36	[kips]	
Flexural yield interaction	ratio = $(\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$		= **0.04**		AISC 14th Eq 10-5
			< 1.0	OK	

Gusset Plate - Flexural Rupture Interact					
	ratio =		= **0.04**	**PASS**	
Gusset plate	width b_p = 20.000 [in]	thick t_p = 0.375	[in]		
	tensile F_u = 65.0 [ksi]				
Net area of plate	$A_n = b_p \times t_p$	= 7.500	[in^2]		
Plastic modulus of net section	$Z_{net} = (b_p \times t_p^2) / 4$	= 37.500	[in^3]		
Flexural strength available	$M_c = \phi F_u Z_{net}$ ϕ=0.75	= 152.34	[kip-ft]		
Flexural strength required	M_r = from gusset interface forces calc	= 0.00	[kip-ft]		
Axial strength available	P_c = from axial tensile rupture check	= 365.63	[kips]		
Axial strength required	P_r = from gusset interface forces calc	= 35.36	[kips]		
Shear strength available	V_c = from shear rupture check	= 219.38	[kips]		
Shear strength required	V_r = from gusset interface forces calc	= 35.36	[kips]		
Flexural rupture interaction	$\text{ratio} = (\frac{V_r}{V_c})^2 + (\frac{P_r}{P_c} + \frac{M_r}{M_c})^2$	= **0.04**		AISC 14th Eq 10-5	
		< 1.0	OK		

Gusset to Column Weld Strength					ratio = 2.50 / 8.78	= **0.28**	**PASS**
Gusset to Column Interface - Forces							
	shear V_c = 35.36	[kips]		axial H_c = -35.36	[kips]	in tension	
	moment M_c = 0.00	[kip-ft]					
Gusset-column fillet weld length	L_{wc} =			= **20.000**	[in]		
Gusset to Column Interface - Combined Weld Stress							
Weld stress from axial force	$f_a = H_c / L_{wc}$			= -1.768	[kip/in]	in tension	
Weld stress from shear force	$f_v = V_c / L_{wc}$			= 1.768	[kip/in]		
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$			= 0.000	[kip/in]		
Weld stress combined - max	$f_{max} = [(f_a - f_b)^2 + f_v^2]^{0.5}$			= **2.500**	[kip/in]	AISC 14th Eq 8-11	
Weld resultant load angle	$\theta = \tan^{-1} [(f_b - f_a) / f_v]$			= 45.0	[°]		
Fillet Weld Strength Calc							
Fillet weld leg size	w = 5/16	[in]		load angle θ = 45.0	[°]		
Electrode strength	F_{EXX} = 70.0	[ksi]		strength coeff C_1 = 1.00		AISC 14th Table 8-3	
Number of weld line	n = 2 for double fillet						
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$			= 1.30		AISC 14th Page 8-9	
Fillet weld shear strength	$R_{n-w} = 0.6 (C_1 \times 70 \text{ ksi}) 0.707 w n C_2$			= 24.076	[kip/in]	AISC 14th Eq 8-1	
Base metal - gusset plate	thickness t = 0.375	[in]		tensile F_u = 65.0	[ksi]		
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked						AISC 14th J2.4	
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$			= 14.625	[kip/in]	AISC 14th Eq J4-4	
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$			= **14.625**	[kip/in]	AISC 14th Eq 9-2	
Resistance factor-LRFD	ϕ = 0.75					AISC 14th Eq 8-1	
	ϕR_n =			= 10.969	[kip/in]		
When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group						AISC 14th Page 13-11	
Weld strength used for design after applying ductility factor	$\phi R_n = \phi R_n \times (1/1.25)$			= **8.775**	[kip/in]		
	ratio = **0.28**			> f_{max}	OK		

Column Web Local Yielding					ratio = 35.36 / 370.23	= **0.10**	**PASS**
Concentrated force from gusset	P_u =			= **35.36**	[kips]		
Column section	d = 11.900	[in]		t_f = 0.515	[in]		
	t_w = 0.295	[in]		k = 1.020	[in]		
	yield F_y = 50.0	[ksi]					
Length of bearing	l_b = Gusset/Column interface length			= 20.000	[in]		
Column web local yielding strength	$R_n = F_y t_w (5 k + l_b)$			= 370.23	[kips]	AISC 14th Eq J10-2	
Resistance factor-LRFD	ϕ = 1.00						
	ϕR_n =			= **370.23**	[kips]		
	ratio = **0.10**			> P_u	OK		

Brace Force Load Case 2 Gusset plate t=0.375 P = 50.00 kips (C) ratio = **0.20** **PASS**

Gusset Plate - Shear Yielding			ratio = 35.36 / 225.00	= **0.16**	**PASS**
Plate Shear Yielding Check					
Plate size	width b_p = 20.000	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_{gv} = b_p t_p$		= 7.500	[in^2]	
Shear force required	V_u =		= **35.36**	[kips]	
Plate shear yielding strength	$R_n = 0.6 F_y A_{gv}$		= 225.00	[kips]	AISC 14th Eq J4-3
Resistance factor-LRFD	ϕ = 1.00				AISC 14th Eq J4-3
	ϕR_n =		= **225.00**	[kips]	
	ratio = **0.16**		> V_u	OK	

Gusset Plate - Shear Rupture			ratio = 35.36 / 219.38	= **0.16**	**PASS**
Plate Shear Rupture Check					
Plate size	width b_p = 20.000	[in]	thickness t_p = 0.375	[in]	
Plate tensile strength	F_u = 65.0	[ksi]			
Plate net area in shear	$A_{nv} = b_p t_p$		= 7.500	[in^2]	
Shear force in demand	V_u =		= **35.36**	[kips]	
Plate shear rupture strength	$R_n = 0.6 F_u A_{nv}$		= 292.50	[kips]	AISC 14th Eq J4-4
Resistance factor-LRFD	ϕ = 0.75				AISC 14th Eq J4-4
	ϕR_n =		= **219.38**	[kips]	
	ratio = **0.16**		> V_u	OK	

Gusset Plate - Axial Tensile Yield			ratio = 35.36 / 337.50	= **0.10**	**PASS**
Plate Tensile Yielding Check					
Plate size	width b_p = 20.000	[in]	thickness t_p = 0.375	[in]	
Plate yield strength	F_y = 50.0	[ksi]			
Plate gross area in shear	$A_g = b_p t_p$		= 7.500	[in^2]	
Tensile force required	P_u =		= **35.36**	[kips]	
Plate tensile yielding strength	$R_n = F_y A_g$		= 375.00	[kips]	AISC 14th Eq J4-1
Resistance factor-LRFD	ϕ = 0.90				AISC 14th Eq J4-1
	ϕR_n =		= **337.50**	[kips]	
	ratio = **0.10**		> P_u	OK	

Gusset to Column Weld Strength							ratio = 1.77 / 8.78	= **0.20**	**PASS**
Gusset to Column Interface - Forces									
	shear V_c = 35.36	[kips]		axial H_c = 35.36	[kips]	in compression			
	moment M_c = 0.00	[kip-ft]							
Gusset-column fillet weld length	L_{wc} =				= **20.000**	[in]			
Gusset to Column Interface - Combined Weld Stress									
Weld stress from axial force	$f_a = H_c / L_{wc}$				= 0.000	[kip/in]	in compression		
Weld stress from shear force	$f_v = V_c / L_{wc}$				= 1.768	[kip/in]			
Weld stress from moment force	$f_b = \frac{M}{L^2 / 6}$				= 0.000	[kip/in]			
Weld stress combined - max	$f_{max} = f_v$				= **1.768**	[kip/in]	AISC 14th Eq 8-11		
Weld resultant load angle	θ = weld only has shear component				= 0.0	[°]			
Fillet Weld Strength Calc									
Fillet weld leg size	w = 5/16	[in]		load angle θ = 0.0		[°]			
Electrode strength	F_{EXX} = 70.0	[ksi]		strength coeff C_1 = 1.00			AISC 14th Table 8-3		
Number of weld line	n = 2 for double fillet								
Load angle coefficient	$C_2 = (1 + 0.5 \sin^{1.5} \theta)$				= 1.00		AISC 14th Page 8-9		
Fillet weld shear strength	R_{n-w} = 0.6 (C_1 x 70 ksi) 0.707 w n C_2				= 18.559	[kip/in]	AISC 14th Eq 8-1		
Base metal - gusset plate	thickness t = 0.375	[in]		tensile F_u = 65.0		[ksi]			
Base metal - gusset plate is in shear, shear rupture as per AISC 14th Eq J4-4 is checked							AISC 14th J2.4		
Base metal shear rupture	$R_{n-b} = 0.6 F_u t$				= 14.625	[kip/in]	AISC 14th Eq J4-4		
Double fillet linear shear strength	$R_n = \min (R_{n-w}, R_{n-b})$				= **14.625**	[kip/in]	AISC 14th Eq 9-2		
Resistance factor-LRFD	ϕ = 0.75						AISC 14th Eq 8-1		
	ϕR_n =				= 10.969	[kip/in]			
When gusset plate is directly welded to beam or column, apply 1.25 ductility factor to allow adequate force redistribution in the weld group							AISC 14th Page 13-11		
Weld strength used for design after applying ductility factor	$\phi R_n = \phi R_n$ x (1/1.25)				= **8.775**	[kip/in]			
	ratio = **0.20**				> f_{max}	OK			

Column Web Local Yielding							ratio = 35.36 / 370.23	= **0.10**	**PASS**
Concentrated force from gusset	P_u =				= **35.36**	[kips]			
Column section	d = 11.900	[in]		t_f = 0.515		[in]			
	t_w = 0.295	[in]		k = 1.020		[in]			
	yield F_y = 50.0	[ksi]							
Length of bearing	l_b = Gusset/Column interface length				= 20.000	[in]			
Column web local yielding strength	$R_n = F_y t_w (5 k + l_b)$				= 370.23	[kips]	AISC 14th Eq J10-2		
Resistance factor-LRFD	ϕ = 1.00								
	ϕR_n =				= **370.23**	[kips]			
	ratio = **0.10**				> P_u	OK			

Column Web Local Crippling				ratio = 35.36 / 264.67	= **0.13**	**PASS**
Concentrated force from gusset	P_u =			= **35.36**	[kips]	
Column section	d = 11.900	[in]		t_f = 0.515	[in]	
	t_w = 0.295	[in]		k = 1.020	[in]	
	yield F_y = 50.0	[ksi]		E = 29000	[ksi]	
Length of bearing	l_b = Gusset/Column interface length			= 20.000	[in]	
	when $l_N \geq d/2$, use Eq J10-4					AISC 14th Eq J10-4
Column web local crippling strength	$R_n = 0.8\, t_w^2\, [1+3\frac{l_b}{d}(\frac{t_w}{t_f})^{1.5}] \times (\frac{E\, F_y\, t_f}{t_w})^{0.5}$			= 352.89	[kips]	AISC 14th Eq J10-4
Resistance factor-LRFD	ϕ = 0.75					AISC 14th J10.3
	ϕR_n =			= **264.67**	[kips]	
	ratio = **0.13**			> P_u	OK	